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(Problem 1b)

STUDY PLAN

THE MITES ASSOCIATED WITH *IPS TYPOGRAPHUS*--A SEARCH FOR EXOTIC MITE PREDATORS OF THE SOUTHERN PINE BEETLE

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John C. Moser and Hermann Bogenschütz

Utilizing mites as control agents of the southern pine beetle (SPB), acting either as individual species or in combination with other animal or plant agents, is a long-term objective of the Southern Forest Experiment Station. The control possibilities are basically of two types: exotic or extraregional mites imported as biological control agents, or those involving manipulation of native mites. The subject of this study deals with exotics.

The theory of structured demes (Wilson 1980) predicts that those native mites dependent upon SPB for transport (phoresy) will not prey on it. The theory also predicts that the closest SPB associates (including some mites phoretic on SPB insect associates) will evolve positive relationships with SPB and will not prey on it. If Wilson's theory is correct, then it would seem that exotic or extraregional mites might offer the best hope for SPB control. The latter idea is supported by Kinn and Witcosky 1977, who show that at least one phoretic native mite thought to be a predator of SPB indeed protects SPB by eating parasitic nematodes.

In 1973, a systematic search was made for exotic mites in Poland under the Special Currency Research Program (PL 480), Kielczewski, et al., unpublished. One hundred eighty-one mite species were taken from galleries of 45 bark beetle species. Of these, about 60 percent may be considered potential predators of bark beetles.

A successful introduction would not only require that a mite be predatory on SPB, but also that the mite ride SPB adults. Moser et al. 1978 records that one of the Polish mites, *Pyemotes dryas*, was an excellent predator of SPB, but that this exotic mite failed to ride beetle adults.

Another study Moser 1981 showed that an extraregional predatory mite from Oregon, *Pyemotes giganticus*, was an excellent rider, but a poor predator.

The current *Ips typographus* trapping program in Europe affords another excellent opportunity to search for exotic mite predators that not only attack SPB brood but ride SPB adults. It also offers a cheap and efficient method of collecting live mites for biological studies, since the beetles are captured live in great numbers.

One of us (Bogenschütz) has been pheromone trapping large numbers of *Ips typographus* in a number of locations in the Black Forest, in the southern forest districts of the State of Baden-Württemberg. Many of the beetles carry mites, some of which may prey on beetle brood. Since large numbers of beetles were being collected over the entire span of the beetle's two spring and summer generations, and since they were from a number of

localities, it occurred to us that this would be an excellent first opportunity to initiate a search for exotic mite predators from a single species of exotic bark beetle. Moser proposed this idea to the RWU 2203 project leader and the Assistant Director - West Gulf, and on August 28, 1980 secured permission from the Assistant Director to initiate an exploratory study. This study plan now formalizes that exploratory study, and outlines procedures for a systematic survey throughout the 1981 season.

METHODS AND MATERIALS

Ips typographus usually has two (and occasionally a partial 3rd) generations per year (Fig. 1) in the state of Baden-Wurtemberg (Fig. 2). The first flight normally begins in late April or early May. In 1980 this flight peaked about June 1. The end of the first flight (Fig. 1, (A)) merged with the beginning of a second flight (Fig. 1, (B)) which mostly consisted of first generation of parent adults. These flights produced a second generation of summer brood adults, indicated by the distinct third flight peak (Fig. 1, (C)) about August 3. Any life stage may overwinter from progeny resulting from this third flight. Brood adults emerging in the fall overwinter in the litter. All stages of brood may overwinter under bark. In the spring, beetles fly in greatest numbers at 20^{o}C. Thus the height and shape of this first peak varies greatly from year to year because it is dependent on spring temperatures.

Moser, unpublished, has shown for the southern pine beetle that the number and species of the various phoretic mites differ not only seasonally, but between brood and parent adults. The 1980 exploratory studies show that this same pattern probably also holds for *Ips typographus*. During

the 1980 season, we sampled 100 beetles for phoretic mites for the weeks 23, 24, 29, and 30 (Fig. 1, (*)). The numbers and kinds of mites for weeks 23 and 24 were very different from those of weeks 29 and 30, supporting our hypothesis that mite species and numbers may differ between the first and second generation.

A complete understanding of this phoretic spectrum requires systematic sampling of flying beetle populations throughout the flight season. In the 1981 season we propose to sample 100 beetles weekly from pheromone traps located at 1100 m. on Ahornkoph Mountain in the Kirchzarten Forstbezirk (Fig. 2). The sample of 100 will be placed in alcohol vials and shipped to Moser, who will tally on 80-column data sheets the number and species of mites per beetle (Table 1). Any mites at the bottom of the vial will also be listed on a separate form (Table 2).

PRELIMINARY COMPUTATIONS AND DATA ANALYSIS

Since this is a preliminary survey, statistical hypotheses have not been formulated at this time. Appropriate tests will be employed after the initial analysis of data.

The preliminary questions are:

1) What species of mites were attached to the beetles?

2) On what part of the beetle body does each mite species attach?

3) What mite species were found in the alcohol dregs? Which are presumed to be phoretic?

4) How common is each of the above mite species in questions 1 and 3?

5) Do the mite species and numbers differ for the three beetle population peaks (Fig. 1; A, B, & C)?

6) Despite sampling methods, can we detect any differences in mite species and numbers between 1980 and 1981?

PRESENTATION OF RESULTS

One or more published articles by Moser and Bogenschütz will be submitted as the final report for this study.

SAFETY AND HEALTH

Since this study involves only the examination of specimens in alcohol, safety hazards are minimal. Care will be taken to observe the usual laboratory precautions.

ENVIRONMENT CONSIDERATIONS

This study may be classed under categorical exclusions (FSM 1952.1(5)) because it is a research activity that has limited context and no intensity in terms of changes in the physical, biological, economic, or social components of the environment.

PERSONNEL ASSIGNMENT

Hermann Bogenschütz	Biologist
John C. Moser	Research Entomologist
Lawrence M. Roton	Biological Laboratory Technician
John W. Monahan	Biological Laboratory Technician

EXPENDITURES

Labor	Man-days
Work Plan -- Moser	5
Process mites in alcohol -- Moser	10
Technician	60
Correspondence -- Moser	7
Final report and/or publication(s)	30
Total	112

Materials	Costs
Slides and mounting materials	$50

FIGURE AND TABLE CAPTIONS

Fig. 1. Flight of *Ips typographus* in the State of Baden-Württemberg in 1980

* - Exploratory survey of phoretic mites

(%) - Percent of flying beetle adults

(A) - Peak of first flight (first generation, overwintering brood adults)

(B) - Peak of second flight (first generation, parent adults)

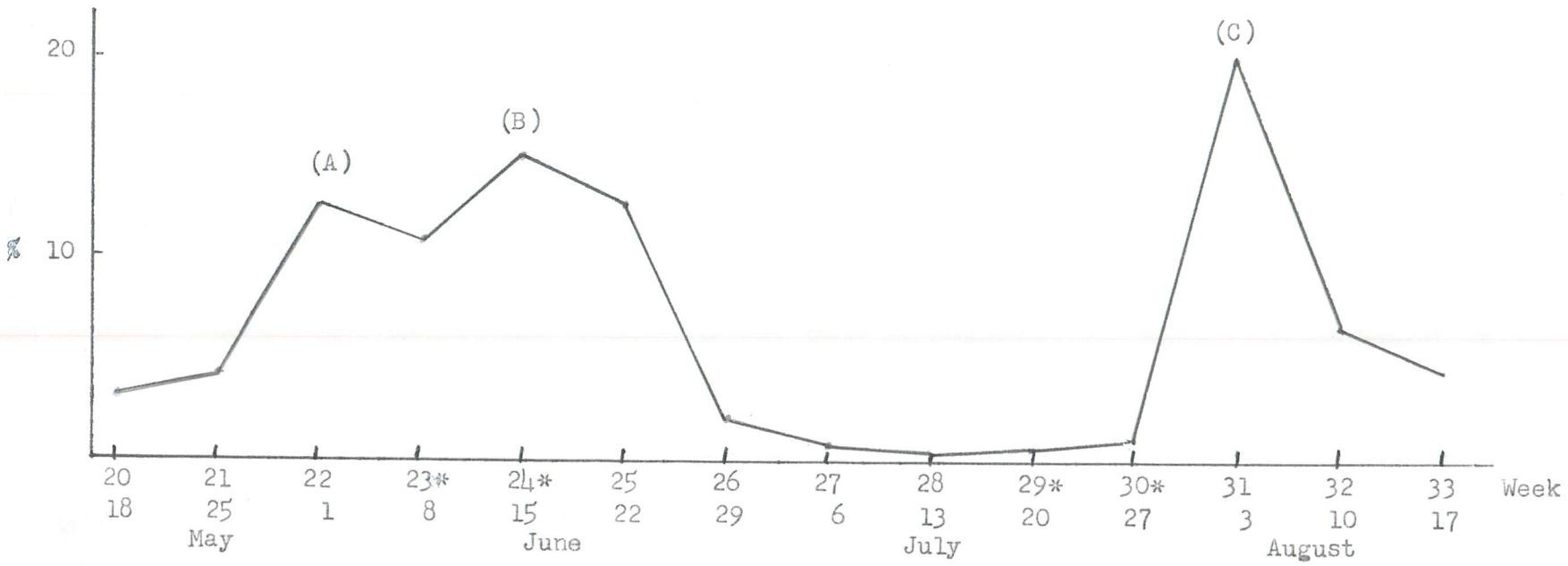
(C) - Peak of third flight (second generation, brood adults)

Fig. 2 Forest Service (Forstbezirkskarte) map for the State of Baden-Württemberg. The heavy lines delineate the four Forstdirektionen (middle administrative level) of the Landesforstverwaltung (Forest Service Division of the State Ministry of Agriculture). The smallest units (Ex. sites of 1980 trapping: Freiburg, St. Märgen, Leutkirch, etc. (circled)) are the lowest administrative units (Forstbezirk) of the Forest Service. Note the location of Kirchzarten, trapping site for both the 1980 and 1981 surveys.

Table 1. Phoretic mites on *Ips typographus* flying adults by species, number, and beetle body location. Data, in part, from 1980 survey.

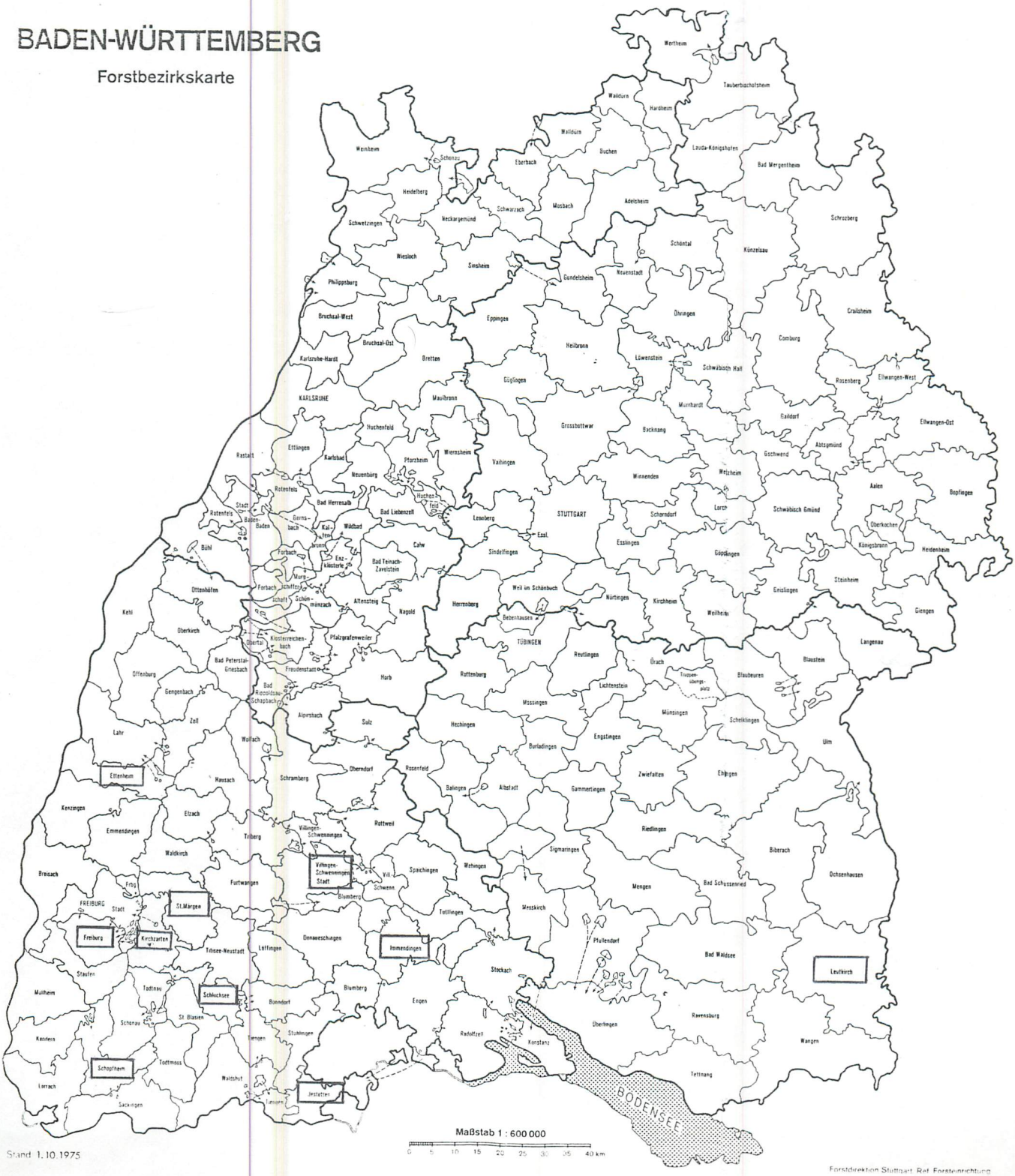
Table 2. Mites found in vial dregs that contained *Ips typographus* in alcohol. Data, in part, from 1980 survey.

Figure 1.



See text for explanation of terms

Figure 2. Forest Service map (Forstbezirkskarte) for the state of Baden-Württemberg.



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DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY	ENTERED BY	DATE	PUNCHED BY	DATE	PURCHASE ORDER	JOB No.
	RESEARCHER	CHECKED BY	DATE	VERIFIED BY	DATE		

| LINE NUMBER | FIELD DESIGNATIONS | | | | | | | | | Mite | | | | | | | | |

DATA LISTING FOR 80 COL. PUNCHED CARD

SOUTHERN FOREST EXPERIMENT STATION T-10210 FEDERAL BUILDING 701 LOYOLA AVENUE NEW ORLEANS, LOUISIANA 70113	STUDY: FS-SO-2203-1.48	ENTERED BY: Dregs	DATE	PUNCHED BY	DATE	PURCHASE ORDER	JOB No.	S
	RESEARCHER: Moser and Bogenschütz	CHECKED BY: *Ips typographus*	DATE	VERIFIED BY	DATE			

Card #1 - Phoretic mites
#2 - Vial dregs

FIELD DESIGNATIONS: Card #, Vial #, Day, Month, Year, Location, Number of beetles in vial

MITE SPECIES

| LINE NUMBER | Card # | Vial # | Day | Month | Year | Location | Number of beetles in vial | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 |
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